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Species Conservation Profiles

Conservation profile of the largest Palearctic silverfish and Europe's largest cave-adapted terrestrial insect: *Squamatinia algharbica* (Zygentoma, Nicoletiidae)

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Abstract

Background

Squamatinia algharbica Mendes & Reboleira, 2012 is an iconic gigantic troglobiont silverfish, which was recently listed endangered in the Portuguese Red List of Invertebrates. It is endemic from caves of the Algarve, the southernmost part of Portugal - a karst area known as Barrocal. This area faces severe threats to cave biodiversity, such as pollution, groundwater overexploitation, land-use change at surface, intensive agriculture and aridity, associated with the lack of concrete protection measures for cave-adapted species.

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New information

Biological prospection of caves in the Algarve karst massif (Portugal) increased the knowledge on the distribution of *S. algharbica*. We provide new distributional data that enlarge the area of occurrence and the first phylogeny for this species. Based on new molecular data, the genus *Squamatinia* appears with an isolated position within the Nicoletiidae family, highlighting *Squamatinia algharbica* as a biological relict with particularly high conservationist value. We assess the conservation status, evaluating the anthropogenic threats to its habitat and present the IUCN Red List profile, based on this new information.

Keywords

Insecta, troglobiont, cave protection, karst, Algarve, Portugal

Introduction

Squamatinia algharbica Mendes & Reboleira, 2012 (Zygentoma, Nicoletiidae) is a giant troglobiont silverfish endemic to caves of the Algarve in southern Portugal, a karst region called the Barrocal, where it was discovered in 2008 (Reboleira et al. 2012a). It belongs to a monospecific genus, included in the family Nicoletiidae, subfamily Coletiniinae (Reboleira et al. 2012a). It is considered similar to the genus *Coletinia* Wygodzinsky, 1980 and *Lepidospora* Escherich, 1905, being characterised by having the body covered with scales (Reboleira et al. 2012a). It is considered the largest cave-adapted terrestrial insect of Europe and it is the largest silverfish of the Palaearctic Region (Reboleira et al. 2012a).

Squamatinia shares the cave habitat with other iconic cave-adapted species, such as the Giant Pseudocorpion of Caves of the Algarve, *Titanobochica magna* Zaragoza & Reboleira, 2010, in an area considered a world class hotspot for subterranean biodiversity (Reboleira et al. 2011, Pennisi 2016, Reboleira and Eusébio 2021, Reboleira et al. 2022, Reboleira and Eusébio 2023).

The cave fauna of the karst area of Barrocal faces many threats related to anthropogenic pressure (Reboleira et al. 2011, Pennisi 2016, Reboleira and Eusébio 2021, Reboleira et al. 2022, Reboleira and Eusébio 2023), in a country that lacks specific conservation measures for the protection of cave-adapted fauna (Reboleira 2025).

Here, we assess the conservation profile of *Squamatinia algharbica*, based on new distribution data, identify the anthropogenic threats for each site, provide the first DNA sequences for the species, compare it with other Nicoletiidae DNA sequences available in GenBank and assess its conservation status.

Material and Methods

Sampling has been conducted since 2008 in caves across the Algarve, using passive (pitfall traps) and active methods, following previously described methodology (Reboleira 2012). Specimens were sorted and identified using optical and scanning electron microscopy.

The extent of occurrence (EOO) and area of occupancy (AOO) was assessed using the Geospatial Conservation Assessment Tool (GeoCAT) with approximation to the IUCN standard 2 km × 2 km cells, corresponding to 4 km^2.

The threats to each studied site were evaluated *in situ* during the fieldwork in the influence area of each cave and also remotely using satellite images obtained in Google Earth software in the year of 2025.

DNA extraction and *COI* Barcode Amplification

DNA was extracted from the specimen's thorax using the DNeasy Blood & Tissue Kit (Qiagen, Valencia, CA, USA), following the manufacturer's standard protocol with some minor modifications. After extraction, the DNA quality was assessed by agarose gel electrophoresis and fluorometric quantification using an Invitrogen Qubit 4 Fluorometer (Thermo Fisher Scientific, Massachusetts, U.S.A.).

Polymerase Chain Reaction (PCR) amplification of the DNA barcode region of the mitochondrial cytochrome oxidase subunit I gene (*COI*) was performed using the primers LCO (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO (5'-TAAACTTCAGGGTG ACCAAAAAATCA-3') (Folmer et al. 1994). The 25 µl PCR reaction contained 5 pmol of each primer, 5 ng of template DNA and was performed in NZYTaq II 2x Green Master Mix which included 2.5 U of Taq (NZYtech, Lisbon, Portugal). Thermal cycling conditions consisted of one cycle of 94°C for 1 minute, five cycles of 94ºC for 30 seconds, 45ºC for 1 minute and 72ºC for 1 minute, followed by 30 cycles of 1 minute at 94°C, 90 seconds at 50°C and 1 minute at 72°C, with a final extension of 7 minutes at 72°C.

Following amplification, PCR products were purified using ExoCleanUp FAST (VWR International, West Chester, PA, USA) by adding 5 µl of ExoCleanUp FAST to each reaction volume, followed by incubation at 37°C for 15 minutes and enzyme inactivation at 80°C for 10 minutes. Bidirectional sequencing at STAB VIDA (Lisbon, Portugal) was performed using the same primers as in the PCR reactions.

DNA Sequence Assembly and Phylogenetic Analysis

Sequence trace files were assembled using *Seqtrace* v.0.9.1 (Stucky 2012). A multispecies sequence alignment containing the newly-obtained *COI* partial fragment of *Squamatinia algharbica* (GenBank Accession PX272274) and sequences for other Nicoletiidae and Lepismatidae species (BOLD Specimen IDs in Suppl. material 5) was produced using Mafft v.7.525 (Katoh and Standley 2013).

Substitution models were inferred using ModelFinder (Kalyaanamoorthy et al. 2017), implemented in IQ-Tree v.2.3.6 (Minh et al. 2020) and the best model was chosen according to the Corrected Akaike Information Criterion. Phylogeny was reconstructed through Maximum Likelihood (ML) and Bayesian Inference (BI) methods. The ML analysis was performed with IQ-Tree v.2.3.6 with 1000 bootstrap replicates and a GTR+F+I+G4. The BI analysis was performed with MrBayes v.3.2.7 (Ronquist et al. 2012), with a chain length set to 1E6 MCMC generations, sampling every 100 generations and a GTR+F+I+G4 substitution model. A consensus tree was obtained with a burn-in fraction of 0.1. Manipulation and plotting of the resulting phylogenetic trees was performed in *R* v. 4.4.3 using packages *ape* v.5.8.1 (Paradis et al. 2004), *treeio* v.1.32.0 (Wang et al. 2019), *tidytree* v.0.4.6 (Yu 2017), *ggtree* v.3.16.0 (Yu et al. 2016) and *ggtext* v.0.1.2 (Wilke and Wiernik 2020).

Species Conservation Profile

Squamatinia algharbica Mendes & Reboleira, 2012

Species information

Common names

Giant silverfish from caves of the Algarve

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Arthropoda	Insecta	Zygentoma	Nicoletiidae

Region for assessment:

- Europe
- Mediterranean

Figure(s) or Photo(s):

Figs 1, 2, 3, 4

Reviewers

Paulo Borges, Miquel Gaju-Ricart, Anonymous reviewer.

Figure 1. doi

Live female of *Squamatinia algharbica* Mendes & Reboleira, 2012, walking over the sediment in the type locality, Vale Telheiro Cave, Loulé, Algarve, Portugal. Photo: Ana Sofia Reboleira.

Figure 2. doi

Live female of *Squamatinia algharbica* Mendes & Reboleira, 2012, walking on the cave wall in the type locality, Vale Telheiro Cave, Loulé, Algarve, Portugal. Photo: Ana Sofia Reboleira.

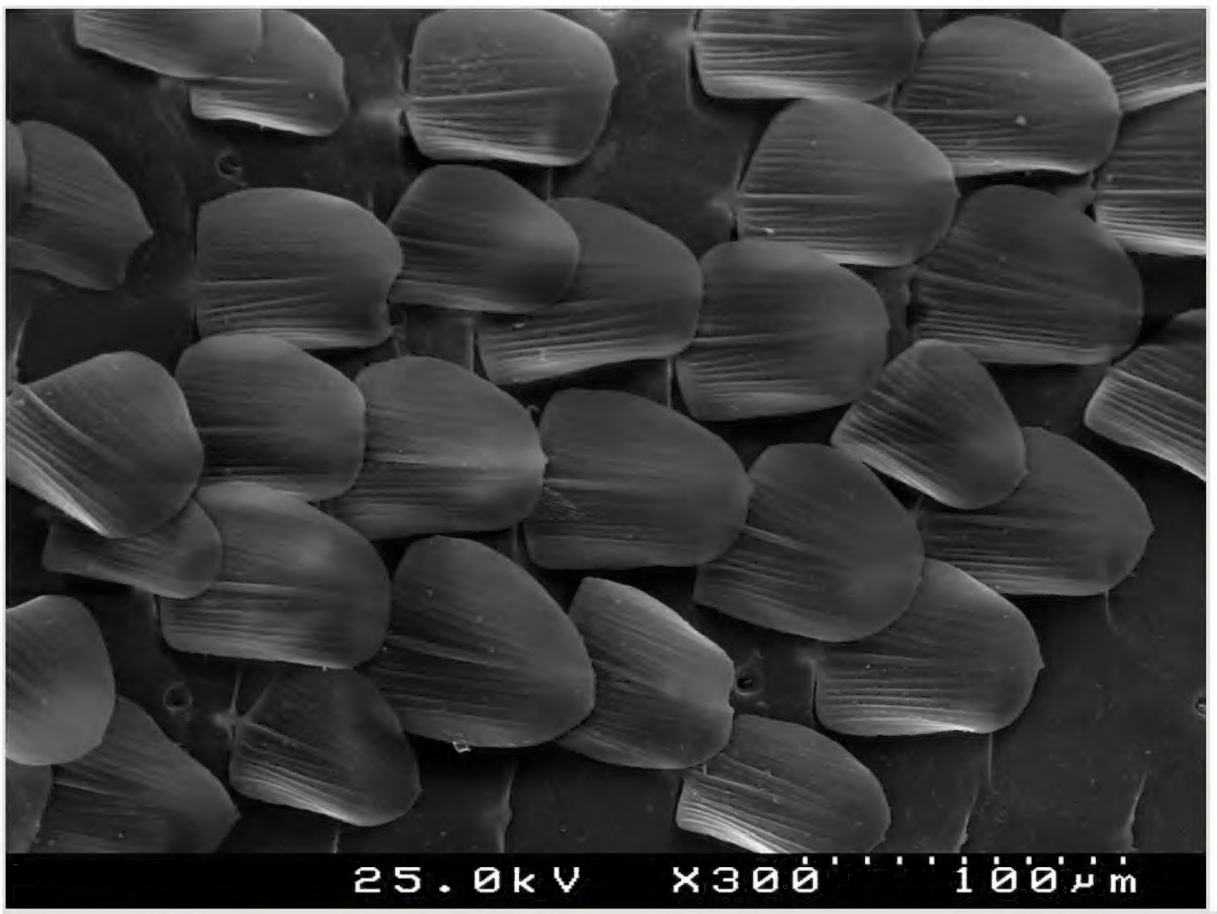

Figure 3. doi

Scanning electron microscope photo of the scales in the surface of the thorax of *Squamatinia algharbica* Mendes & Reboleira, 2012, male. Photo: Ana Sofia Reboleira.

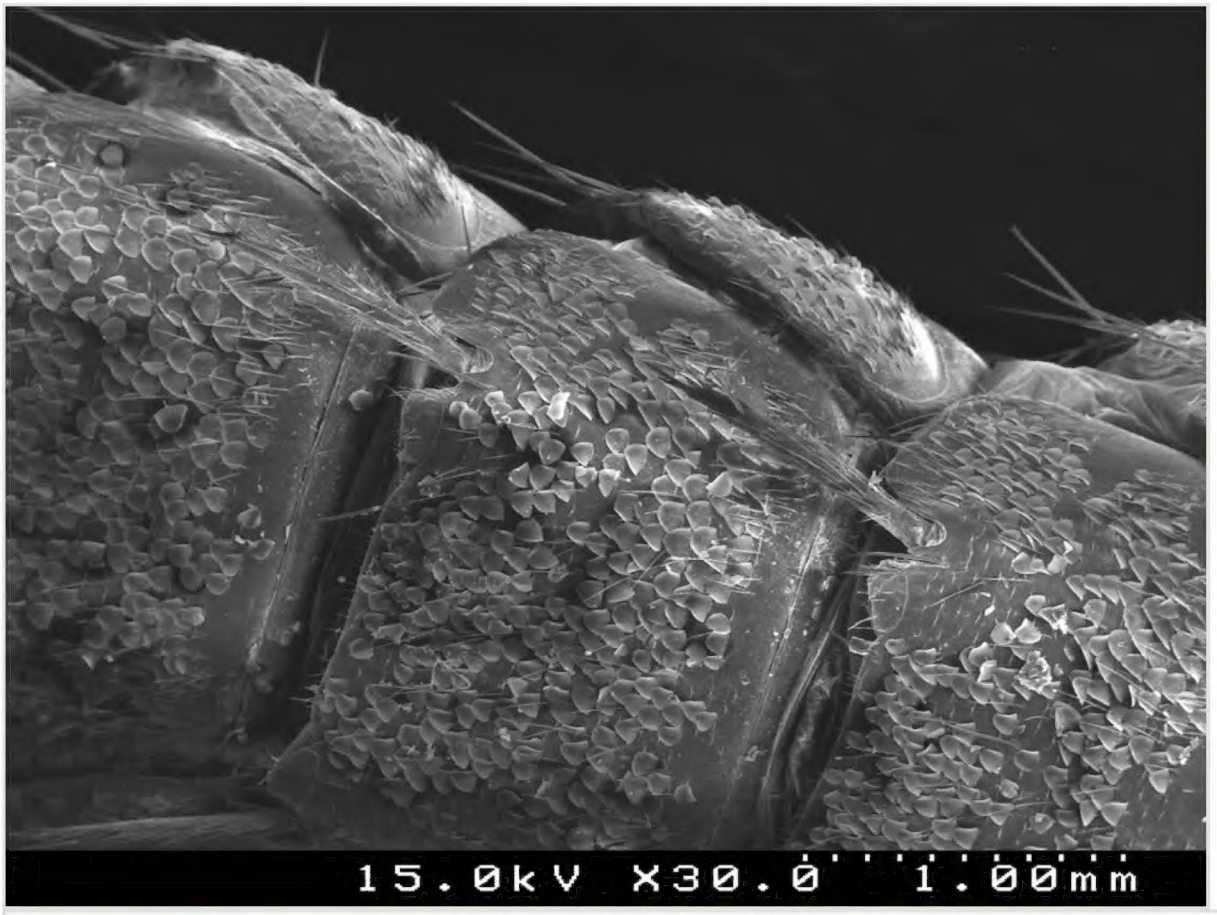

Figure 4. doi

Scanning electron microscope photo of the ventral view of the urosternites, *Squamatinia algharbica* Mendes & Reboleira, 2012, male. Photo: Ana Sofia Reboleira.

Editor

Chen-Yang Cai.

Geographic range

Biogeographic realm:

- Palearctic

Countries:

- Portugal

Map of records (Google Earth):
Suppl. material 1

Basis of EOO and AOO: Observed

Basis (narrative)

Squamatinia algharbica is endemic to the Algarve, the southernmost province of Portugal.

Min Elevation/Depth (m): 10

Max Elevation/Depth (m): 283

Range description

Squamatinia algharbica is distributed along the karst region of the Algarve, the so-called Barrocal. The westernmost known location is Ibne Ammar (= Ibn Ammar) Cave, in Mexilhoeira da Carregação, Lagoa and the easternmost is Gruta da Senhora in Moncarapacho, Olhão. The northernmost distribution is the Remexido Cave in São Bartolomeu de Messines and the southernmost is Abismo Novo in Moncarapacho, Olhão. The maximum altitude is in Algarinhos de Benafim Cave (283 m a.s.l.) in Benafim, Loulé and the lowest altitude is Ibne Ammar Cave (10 m a.s.l.).

Extent of occurrence

EOO (km2): 457.889

Trend: Decline (inferred)

Justification for trend

All extent of occurrence is subterranean within the Algarve karst massif (Suppl. material 2). The extent of occurrence has increased, compared to the information available in the

Portuguese Red List of Invertebrates (Boieiro et al. 2023), because of the adition of several new cave localities for *Squamatinia algharbica*.

Causes ceased?: Unknown

Causes understood?: Unknown

Causes reversible?: Unknown

Extreme fluctuations?: Unknown

Area of occupancy

AOO (km2): 32,000

Trend: Decline (inferred)

Causes ceased?: Unknown

Causes understood?: Unknown

Causes reversible?: Unknown

Extreme fluctuations?: Unknown

Locations

Number of locations: 8

Justification for number of locations

Squamatinia algharbica was collected in eight caves along the Barrocal Karst area in the southernmost province of Portugal, the Algarve. The type localities: Gruta de Vale Telheiro, Loulé (holotype); Gruta de Ibne Ammar, Lagoa; Algarão do Remexido (= Caverna do Barranco), Silves; Senhora, Olhão (Reboleira et al. 2012a). Plus, the new localities Algarinhos de Benafim, Loulé; Algar do Penico, Loulé; Abismo Novo, Olhão; and Algar do Romão, Tavira.

Trend: Stable

Extreme fluctuations?: Unknown

Population

Trend: Decline (inferred)

Justification for trend

Hitherto, there are eight populations known, which seem to be isolated in different caves. It is likely that the species is distributed across all the subterranean domains of the Barrocal, whenever caves have enough moisture, as there might be continuity of fractures and small voids across the deep karst. The habitat distribution has severely fragmentated and *S. algharbica* occur in small, presumably isolated subpopulations with limited dispersal (Reboleira et al. 2012a). Additionally, there is very low probability of recolonisation between and across the Barrocal Limestone area, where each cave acts as a small, isolated patch separated by an unsuitable matrix composed of other lithology, such as schists and greywackes and is limited at the south by the Atlantic Ocean. In addition, surface dispersal of this large troglobiont species is very unlikely due to the low humidity in the semi-arid conditions of Algarve's future climate predictions (Andrade et al. 2021).

Basis for decline:

- (a) direct observation
- (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

Causes ceased?: No

Causes understood?: Yes

Causes reversible?: Unknown

Extreme fluctuations?: Unknown

Subpopulations

Trend: Unknown

Extreme fluctuations?: Unknown

Habitat

System: Terrestrial

Habitat specialist: Yes

Habitat (narrative)

Squamatinia algharbica was found only in caves, from the deepest to the most superficial parts of caves of the Algarve (Reboleira et al. 2012a). It is plausible that it may be also distributed along the mesovoid shallow substratum (MSS) (Reboleira et al. 2012a, Boieiro et al. 2023); nevertheless, there are very reduced areas of MSS in the Algarve karst massif, which are mostly confined to the Rocha da Pena protected landscape in Loulé. This species is found dwelling on cave floors (*Suppl. material 3*) and crawling in

between cave sediments or over roots (*Suppl. material 4*). The caves inhabited by *Squamatinia algharbica* typically have high relative humidity and stable temperature that ranges from 17 to 19.5ºC, at the sediment level (Medina et al. 2023, *Reboleira and Eusébio 2023*). It was found in caves with entrances ranging from 10 up to 283 m a.s.l. (Suppl. material 1).

Trend in extent, area or quality?: Unknown

Habitat importance: Major Importance

Habitats:

- 7. Caves and Subterranean Habitats (non-aquatic)

Ecology

Size: 26.4 mm

Generation length (yr): 3

Dependency of single sp?: Unknown

Dependent on IUCN Status: Endangered (EN)

Ecology and traits (narrative)

Squamatinia algharbica is the largest terrestrial cave-adapted insect in Europe and it is the largest silverfish (order Zygentoma) in the Palaearctic Region, females being typically larger than males and may reach 26.4 mm of body length. It has the body covered with scales and has extreme troglomorphic traits: depigmented body, extreme appendages elongation, including legs, antennae, palps, cerci and terminal filament. This species can be observed all year round in caves of the Algarve, having an abundance peak in summer and decreasing in winter (Reboleira et al. 2012a). A female was kept in lab conditions with controlled temperature (17ºC) and high humidity, for more than 2 years, apparently without feeding or moulting. Its lifespan in the wild is unknown. The gastric content had observable vegetable cells (Reboleira et al. 2012a). *Squamatinia algharbica* shares habitat with several cave-adapted species, such as: the pseudoscorpions *Occidenchthonius goncalvesi* Zaragoza & Reboleira, 2018, *O. algharbicus* Zaragoza & Reboleira, 2018 (Zaragoza and Reboleira 2018), *Lusoblothrus aenigmaticus* Zaragoza & Reboleira, 2012 (Reboleira et al. 2012b) and *Titanobochica magna* Zaragoza & Reboleira, 2010 (Reboleira et al. 2010b); the spiders *Harpactea stalitoides* Ribera, 1993 and *Teloleptoneta synthetica* (Machado, 1951) (Reboleira et al. 2011); the millipedes *Boreviulisoma barrocalense* Reboleira & Enghoff, 2013, *Acipes machadoi* Enghoff & Reboleira, 2013 and *A. bifillum* Enghoff & Reboleira, 2013 (Enghoff and Reboleira 2013, Reboleira and Enghoff 2013, Reboleira and Eusébio 2023); the crustaceans *Cordioniscus lusitanicus* Reboleira & Taiti, 2015, *Trogleluma machadoi* (Vandel, 1946) (Reboleira et al. 2015); the dipluran *Litocampa mendesi* Sendra & Reboleira, 2010

(Reboleira et al. 2010a) and the beetle *Speonemadus algarvensis* Reboleira, Fresneda & Salgado, 2017 (Reboleira et al. 2017). This species tolerates low levels of atmospheric oxygen, below 17% and extremly high levels of CO_2, higher than 50,000 ppm, conditions that occour seasonally in its type locality (Vale Telheiro Cave) (Reboleira and Ambiente 2025). *Squamatinia algharbica* also tolerates salinity on the substrate, as observed in Ibne Ammar, an anchialine cave, that habours a brackish lake with tidal variation (Reboleira et al. 2012a).

Threats

Threat type: Ongoing

Threats:

- 1. Residential & commercial development
- 2. Agriculture & aquaculture
- 9. Pollution
- 3. Energy production & mining
- 4. Transportation & service corridors
- 6. Human intrusions & disturbance
- 7. Natural system modifications
- 11. Climate change & severe weather

Justification for threats

The entrance of the type locality - the Vale Telheiro Cave, in Loulé - distances 26 m from landfills, 82 m from an asphalted road, whose borders are used for deposition of garbage and debris from civil construction and 135 m from the nearest construction, which is surrounded by extensive land-use modification at the North of the cave with removal of "megalapiás" (karst elevated blocks on the landscape). This is one of the largest caves of the Algarve and, therefore, has high visitation pressure from recreational spelunkers.

Algarinhos de Benafim, in Loulé, distances 31 m from an intensive agricultural field whose surface has recently been completely changed including removing all vegetal cover and the surface rock (limestone pavement). It is located 385 m from the closest asphalt road and 320 m from the closest urbanisation. Despite the relative remote location, the entrance pit has been used for dumping trash, which is widely dispersed in the nearest entrance.

Algar do Penico, in Loulé, is located in an area with high cave density, the so-called Varejota, its entrance being distant 500 m from a large limestone quarry and 560 m from the closest asphalted road and urbanisation.

Senhora Cave, in Olhão, is located in the right border of the walking path up to the Cerro da Cabeça Mountain (part of Serra de Monte Figo). It has suffered by significant efforts to transform it into a show cave in the 1970s, the entrance being walled up and it has large

amounts of oxidised iron along the entrance pit, which currently poses a threat to visitors. It is located 232 m from the closest urbanisation and 285 from the closest asphalt road. It is used for garbage deposition through the entrance to the cave.

Abismo Novo Cave, in Olhão, is located also in the Cerro da Cabeça, at a lower altitude than Senhora Cave, within a limestone pavement area (lapiaz), its entrance distances 40 m from intensive agriculture and 75 m from the closest urbanisation. It has a geocache inside, the cave being listed in the geocaching site (Geocaching 2025) and, therefore, has intensive touristic visitation. All over the cave, there are records of human presence, with writings on the cave walls and intense stomping on the sediment.

Algarão do Remexido (= Caverna do Barranco), in Silves, is located below an area with orange cultivation, its entrance distances 45 m from a heavy traffic road; on the other side of the road, there are large fields of intensive agriculture, in what constitutes the draining recharge area of the cave system.

Algar do Romão, in Tavira, is located 325 m from the closest urbanisation and 150 m from agricultural land.

Ibne Ammar Cave, in Lagoa, is the largest cave of the Algarve and is a horizontal cave with high pressure from visitation. It is located 366 m from a highway with heavy traffic. It has a subterranean stream that has a hydrological connection with the margin of the Arade River estuary; the cave harbours a subterranean lake that fills with brackish water from the stuarium at each tide which transports high organic matter content into the cave and potentially pollutants.

Conservation

Conservation action type: In Place

Conservation actions:

- 1. Land/water protection
- 2. Land/water management
- 3. Species management
- 4. Education & awareness
- 5. Law & policy

Conservation action type: Needed

Conservation actions:

- 1. Land/water protection
- 2. Land/water management
- 3. Species management
- 4. Education & awareness
- 5. Law & policy

Justification for conservation actions

The type locality of *Squamatinia algharbica*, the Vale Telheiro Cave, is considered one of the geosites of the UNESCO Algarvensis Geopark, that harbours worldwide unique biodiversity values, that are part of the identity of the Loulé territory and for its uniqueness at a national level, being the only world-class subterrranean biodiversity hotspot in Portugal (Reboleira 2025, Reboleira and Ambiente 2025). The Municipality of Loulé classified this cave as a protected area, under the figure of Natural Local Monument ("Monumento Natural Local da Gruta de Vale Telheiro", in Diário da República n.º 11/2026) to conserve this unique site (Reboleira and Ambiente 2025; DL 2026).

The distribution of *Squamatinia algharbica* is partially covered by the Natura 2000 Network, where "Caves not explored by tourism" are included as habitats to protect. Nevertheless, this lacks implementation and does not guarantee the effective protection of the habitat and its specialist species. It is essential to biologically prospect new caves and shallow subterranean habitats (MSS) to better understand the distribution, abundance, ecology and population dynamics of *S. algharbica*, which will support the development of a specific conservation plan for the species.

The regular monitoring of *Squamatinia algharbica* populations is recommended to understand its seasonal dynamics, a pattern already observed previously (Reboleira et al. 2012a). There should be a concerted effort by the competent authorities to mitigate the negative impacts of the threats hitherto identified in the areas where the species occurs, by limiting anthropogenic disturbance at the surface, ensuring the mosaic of natural habitats at the surface, fundamental for nutrient cycling into the underground and limiting groundwater overexploitation that increases the aridity of the territory and consequently of the subterranean habitats.

Phylogeny

The phylogenetic tree inferred through Bayesian Inference analysis, shows that Lepismatidae and Nicoletiidae are recovered as two fully supported clades (Fig. 5). Inside the Nicoletidae family, the four known subfamilies Subnicoletiinae, Atelurinae, Coletiniinae and Cubacubaninae were recovered, but the relative topology is uncertain (Fig. 5). The genus *Squamatinia* is well differentiated inside a well-supported clade, based on the Bayesian analysis results, formed by the Atelurinae, Coletiniinae and Cubacubaninae subfamilies, which suggest that it also formed a distinct subfamily (Fig. 5). Additionally, this preliminary results also suggest a paraphyletic nature for the Atelurinae subfamily, since the subfamily Coletiniinae is also part of the same clade.

Discussion

Conservation of cave-adapted fauna is a crucial, yet often overlooked, component of biodiversity preservation (Mammola et al. 2019). Caves are windows to wider subterranean ecosystems, that are home to a wide range of habitat specialist which have

high endemism patterns, meaning they are found nowhere else in the world, as happens to *S. algharbica* (Reboleira et al. 2012a). These include complex trophic chains, which heavily rely on organic matter input from the surface (Ravn et al. 2020) and are mainly composed by invertebrates and microorganisms that have evolved to survive in total darkness, nutrient-limited and stable, but fragile environmental conditions (Castaño-Sánchez et al. 2020).

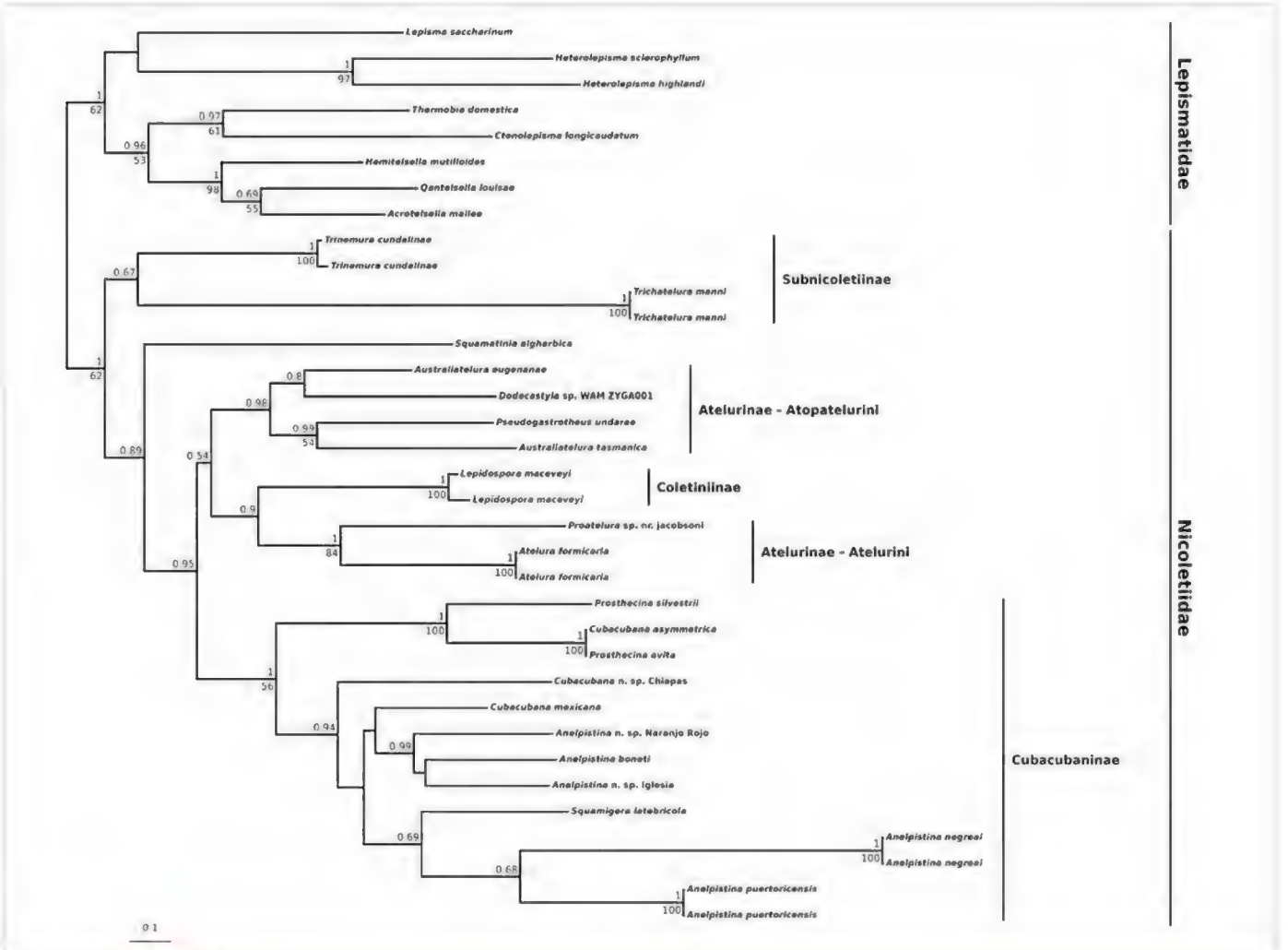

Figure 5. doi

Tree showing the phylogenetic reconstruction of Nicoletiidae and Lepismatidae COI barcode sequences produced by Bayesian Inference analysis. Tip labels show species-level taxonomic identification. Branch support is shown as the posterior probability values produced by the Bayesian Inference analysis (above branch) and bootstrap values produced by the Maximum Likelihood Analysis (below branch). Only values above 0.5 of posterior probability or 50% of bootstrap are shown. The tree was manually rooted on the branch connecting Lepismatidae and Nicoletiidae.

Squamatinia algharbica is a cave-adapted – a troglobiont – with extreme troglomophic traits and gigantic size (up to 2.6 cm), making it the largest cave-adapted terrestrial insect of Europe (Reboleira et al. 2012a). It is distributed across the karst massif of the Algarve, the so-called Barrocal, where it is endemic. This species has only been found in eight caves, from an altitude of 10 m a.s.l. up to 283 m a.s.l. Our results allow us to increase the extent of occurrence (EOO) from 22 to 32 km^2 and an estimated area of occupancy (AOO) from 333 to 458 km^2 (Boieiro et al. 2023), this being evidence that the species may be widely distributed in the subterranean domain of the Barrocal karst massif.

Our phylogenetic analysis confirms that *Squamatinia algharbica* represents an isolated taxa in western Europe (Reboleira et al. 2012a), lacking any closely-related genera that have been previously sequenced (Mitchell et al. 2021). Therefore, *Squamatinia algharbica* is a biological relict with particularly high conservationist value. Based on the Cytochome Oxidase subunit I gene (COI) partial sequence, the position of *Squamatinia algharbica* is inside the family Nicoletiidae, but in a distinct position in relation to all other known subfamilies, with a high posterior probability of forming a group with three other subfamilies Atelurinae, Coletiniinae and Cubacubaninae. It is currently included in the Coletiniinae subfamily, but, based on our new mitochondrial DNA data, it has a quite distinct position in relation to Coletiniinae. Future efforts should be placed in sequencing closely-related genera *Coletinia* Wygodzinsky, 1980, *Lepidina* Silvestri, 1949 and *Pseudobrinckina* Mendes, 2002, to better understand its phylogenetic relationships within Nicoletiidae.

Squamatinia algharbica is currently the most widely cave-adapted distributed species of the troglobionts endemic to the Algarve; therefore, it can act as an umbrella species for the conservation, ensuring that the protection of *Squamatinia algharbica* is fundamental for the conservation of Algarve cave-adapted fauna. This species faces many threats, such as: direct habitat destruction, for example, limestone quarrying,the impressive "Cimpor - Fábrica de Cimento" in Loulé, with an estimated area of more than 5 km^2, the expanding urban development and infrastructures such as roads, that can physically destroy the caves and/or alter their microclimates; pollution: from direct garbage deposition, extensive agricultural runoff, sewage, urban and industrial sewages that contaminate percolating waters; human disturbance: unregulated tourism, intensive visitation as happens for caves listed for geocaching and vandalism. These are all threats that require rapid action to prevent permanent habitat destruction to protect *S. algharbica* from extinction.

This conservation profile for *S. algharbica* proposes necessary interventions, including identification of priority cave habitats for protection and for the establishment of new protected areas. It offers a reliable and comprehensive resource for future land-use, policy-makers, stake-holders and conservation managers to develop future cave-adapted species conservation plans.

Funding program

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Ethics and security

All specimens have been collected under licence of the Instituto de Conservação da Natureza e das Florestas. Specimens are deposited in the Entomological Collection of the National Museum of Natural History and Science, University of Lisbon.

Conflicts of interest

The authors have declared that no competing interests exist.

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Supplementary materials

Suppl. material 1: Occurrences of *Squamatinia algharbica* Mendes & Reboleira, 2012 doi

Authors: Reboleira, A.S.P.S.
Data type: occurrences
Brief description: *Squamatinia algharbica* Mendes & Reboleira, 2012, sampling locations in the Algarve, southernmost part of Portugal.
Download file (31.90 kb)

Suppl. material 2: EEO and AOO of *Squamatinia algharbica* Mendes & Reboleira, 2012 doi

Authors: Reboleira, A.S.P.S.
Data type: occurrences
Download file (7.89 kb)

Suppl. material 3: *Squamatinia algharbica* Mendes & Reboleira, 2012 walking on the rock doi

Authors: Reboleira, A.S.P.S.
Data type: multimedia
Brief description: Video of *Squamatinia algharbica* Mendes & Reboleira, 2012 walking on the type locality, Gruta do Vale Telheiro, Loulé, Portugal.
Download file (12.32 MB)

Suppl. material 4: *Squamatinia algharbica* Mendes & Reboleira, 2012 walking on roots doi

Authors: Reboleira, A.S.P.S.
Data type: multimedia
Brief description: *Squamatinia algharbica* Mendes & Reboleira, 2012 walking over pending roots at the type locality, Gruta do Vale Telheiro, Loulé, Portugal.
Download file (19.28 MB)

Suppl. material 5: Nicoletiidae GenBank Accession Numbers doi

Authors: Reboleira, Galhofa, Viegas & Paulo
Data type: phylogenetic
Brief description: Nicoletiidae GenBank Accession Numbers used in the phylogenetic tree.
Download file (2.07 kb)